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The Amphibians and Reptiles of Tulsa County, Oklahoma, and Vicinity

By Edith R. Force

THIS brief account of the amphibians and reptiles of Tulsa County, Oklahoma, and the adjacent corners of Osage, Creek and Rogers counties, has been prepared principally to meet the needs of students of the wild life of the region and to stimulate a greater interest in and appreciation of our *live* wild animals. It also puts on record numerous original observations on many of the species and presents a check list of the amphibians and reptiles actually to be found in this vicinity.

While the collections on which this report is based were largely made by the writer in the periods from May 29 to September 1, 1928, and 1929, they include also about a thousand miscellaneous specimens collected by the writer and students of Wilson Junior High School since September, 1926, and some specimens available in the Tulsa City Schools[1] and in the private collection of Mr. and Mrs. A. E. Gilmore. A total of 52 species and subspecies,—ten amphibians, twelve lizards, thirty snakes, and eight turtles,—are represented. Records of the structural characters of the snakes are based solely on specimens obtained in this region. To make the report more complete, the records of Ortenburger (1926) have been included when they differ from those otherwise represented.

The habitats of this region are varied. The outcropping rock is shale, sandstone, limestone, and coal; the soil is residual and loess. The Arkansas River meanders in a wide bed from the Keystone, on the west, south through the city of Tulsa in the central part of the county. Between the rocky, wooded Osage Hills on the west and the rugged, beautiful Conchardy Mountains on the southeast lie the bottom lands of the Verdigris and Caney rivers, and Mingo, Bird, Ranch and other creeks. Here the rich soil supports a luxuriant growth of vegetation (Force, 1928).

While nearly all of the county is under cultivation, or at least fenced, there are fortunately small areas of unaltered prairie, natural woodland, and undrained river bottom where, in the proper season, wild life is abundant. The two thousand acres of Mohawk Park and surrounding areas to the north, the Keystone Road, Turkey Mountain, Lost City and Parthenia Park to the south and west, Conchardy Mountain ridge and Mingo Country Club grounds to the south and east, together with vacant lots, prairies, shale pits, coal mines, Wildwood, Woodward Park, and Woody Crest, furnished varied haunts for collecting.

The writer wishes to express her appreciation of the kindness of Dr. P. P. Claxton, ex-superintendent of city schools, and of the Board of Education of Tulsa, for the use of the building and equipment of the Wilson Junior High School, and of the Triangle Blue Print Company for the use

[1] Central High School and Horace Mann, Roosevelt and Wilson Junior High Schools.

of a binocular microscope. Further acknowledgement is due to Dr. F. N. Blanchard, and to Mr. and Mrs. H. K. Gloyd, of the University of Michigan, for the identification of specimens and for advice and suggestions during the preparation of the manuscript; to Mr. Karl P. Schmidt, Field Museum of Natural History, for identifications of frogs and toads; to S. C. Bishop, University of Rochester, New York, for checking the *Ambystoma,* and to the late J. Paul Jones for the identification of *Sceloporus;* to Mr. L. G. E. Bignell, Mrs. R. B. Ward, and Hugh Davis, Jr., for photographic assistance; and to many other friends and students, especially Mr. and Mrs. A. E. Gilmore, Miss Isabelle Borders, Eugene Skipper, and Dwight Johnson, for the constant assistance in the collection and care of the animals.

List of Species

AMPHIBIANS

1. *Necturus maculosus* (Rafinesque)
Mudpuppy; waterdog

Commonly found in mud of ponds and ditches. Three lived all winter in an aquarium. Five immature specimens collected March 5, 1927, from a small water-hole, lived on a vegetable fish food compound for several months. April 10, 1928, a ten and a half inch specimen (A. G. 1) was taken on a fish hook baited with a minnow.

2. *Ambystoma texanum* (Matthes)
Texas salamander

Common in an abandoned coal pit east of Tulsa. One was collected June 3, 1929, from a shallow burrow in wet clay, under a heavy paper carton.

3. *Bufo woodhousii* Girard
Toad

Common. Eggs were collected March 25, 1929; at the same time tadpoles were transforming.

4. *Acris gryllus* (Le Conte)
Cricket-frog

Fairly abundant along edges of small creeks, bordering grassy, wooded areas.

5. *Pseudacris occidentalis* (Baird and Girard)

Rare. Two specimens collected March 20, 1929, by William Bailey, were identified by Dr. F. N. Blanchard as this species.

6. *Hyla versicolor versicolor* (Le Conte)

Common tree frog

Fairly common. Several collected March 20, 1929, were identified by Dr. F. N. Blanchard as belonging to this form.

7. *Rana areolata* Baird and Girard

Northern gopher-frog

One specimen, at this time the only known record for the state, was collected in September, 1927, and identified by Dr. Blanchard. It was found at the edge of College Creek by Elbert Harder.

8. *Rana catesbeiana* Shaw

Bullfrog

Very common in favorable habitats throughout the region.

9. *Rana sphenocephala* (Cope)

Southern leopard-frog

Very common. Collected from early in the spring until late October. Eggs were being laid on March 25, 1929.

10. *Gastrophryne carolinensis* (Holbrook)

Fairly common in damp soil, under pieces of limestone or sandstone. The earliest spring date is April 1.

LIZARDS

11. *Crotaphytus collaris* (Say)

Collared lizard; mountain boomer

Very common on all rocky, wooded hillsides, in shale pits, and often about oil wells. The earliest collection in the spring was made on March 10. Eggs were deposited in captivity on June 20, 1926 (E. R. F. 1), and July 2, 1928 (W. J. H. 405). The eggs were pinkish and cylindrical. They measured 21.4 to 25 mm. in length and 10.55 to 13.7 in diameter.

12. *Sceloporus undulatus thayerii* (Baird and Girard)

Yellow-banded swift

The common subspecies of this vicinity, as identified by the late J. Paul Jones. Found in practically all suitable habitats. In captivity it fed on house flies and small insects. June 8, 1928, a female (W. J. H. 412) deposited 6 pinkish eggs; the next morning three more, and four days later, another. The average size was 10 mm. in length by 6 mm. in diameter.

13. *Sceloporus undulatus undulatus* (Latreille)
Pine lizard; fence lizard

This subspecies has been accredited to Tulsa County by Ortenburger (1926).

14. *Phrynosoma cornutum* (Harlan)
Horned lizard; horn-toad

Very common in prairies, about private grounds and in wooded, rocky, areas, from late March until the middle of October. June 22 and July 2, 1928, two females (A. G. and W. J. H. 406) deposited 21 and 20 eggs respectively, which averaged 12 mm. in length and 8.5 mm. in diameter. Embryos removed August 26 from eggs deposited July 2, were well developed specimens with clear color patterns, active legs, and distinct heart beats. On September 7 four others hatched.

15. *Ophisaurus ventralis* (Linné)
Glass-snake; legless lizard

Occasionally collected in the open during the day, in the brush and leaves about fallen trees, in a grassy field at the edge of the city, from April until October. A specimen preserved by Isabelle Borders May 27, 1929, from Okmulgee County, had 15 eggs, averaging in size 100 by 75 mm. A female collected in May, 1929, deposited 4 eggs July 23, 1929. They measured 100×80 mm., 102×80 mm., 102×70 mm., and 105×70 mm. They did not hatch. A specimen kept in captivity for two years fed readily on grasshoppers and the soft body parts of June beetles, and shed frequently during the spring and summer.

16. *Cnemidophorus gularis gularis* Baird and Girard
Spotted race-runner

This species is reported by Ortenburger (1926) from Tulsa County.

17. *Cnemidophorus sexlineatus* (Linné)
Race-runner; six-lined lizard

Common. On June 5, 1929, a female (W. J. H. 413) deposited four pinkish eggs averaging 15.7 mm. in length and 7 mm. in diameter. In captivity race-runners feed readily on insects.

18. *Leiolopisma laterale* (Say)
Ground lizard

Fairly common and easily collected from under rocks, and in all habitats where snakes and lizards are found. Taken from April 1 to the middle of October. Specimens collected in Tulsa County have been reported by Gloyd (1928) as having deposited eggs between June 9 and 27. On June 11, 1928, a female, in the possession of the writer, deposited four creamy, ovoid eggs, averaging 8 mm. in length and 4.5 mm. in diameter.

19. *Eumeces anthracinus* (Baird)
Coal-skink

Fairly common in the same localities and habitat as *Leiolopisma laterale.*

20. *Eumeces fasciatus* (Linné)
Blue-tailed skink; five-lined skink

Abundant from April to the middle of October. It is frequently found living on the ground among dried leaves, or climbing live trees.

21. *Eumeces obsoletus* (Baird and Girard)
Sonoran skink

Rather infrequent in museum collections in this vicinity. It is found from April 15 until early June, under rocks, in open fields, and near shale and coal pits containing water.

22. *Eumeces septentrionalis* (Baird)
Northern skink

Rare. Two specimens (H. M. 18, T. H. S. 12) from the natural history collection of the Tulsa City Schools were identified as this species by Blanchard.

SNAKES

23. *Leptotyphlops dulcis* (Baird and Girard)
Blind snake

Very rare (Ortenburger, 1926). Three specimens from Tulsa County extend the known northeastern range of this species. They are listed in the museum of the Wilson Junior High School, Tulsa, Oklahoma, as W. J. H. 63 and 117, collected May 9, 1927, and W. J. H. 465, collected June 14, 1928. In captivity these blind snakes burrowed and refused to eat insects or earthworms. Specimen W. J. H. 465 measured 135 mm. in length. It was slow in movements, but the body muscles seemed very strong when it twisted about a finger. The specimens recorded were of a beautiful iridescent, pinkish lavender color, with a silvery sheen.

24. *Carphophis amoena vermis* (Kennicott)
Worm-snake

Considered rare, since less than a dozen were taken in three years. One was plowed up March 24, 1928, by Cecil Maxey. Others were collected on wooded hills near water, under limestone and sandstone rocks. In captivity, although they were timid and hid, they fed on earthworms, the young more readily than the adult. Two females (W. J. H. 26 and 27) taken May 2, 1927, by Ted Rudisell, contained respectively 12 and 8 eggs, 5 to 10 mm. in length and 2 mm. in diameter.

25. *Diadophis punctatus arnyi* (Kennicott)
Ring-neck snake

Quite abundant in all habitats favorable to burrowing forms. Found under paper, tree trunks, leaves, rotted logs, and in gravel and sand of the railroad tracks. One was found by James Taylor under a rock in the act of eating an earthworm. On June 20, 1928, a female deposited four irregular deep yellow eggs, averaging 16 mm. in length by 6 mm. in diameter. Two others deposited one egg each measuring 37 mm. by 7 mm. and 52 mm. by 7 mm.

26. *Heterodon contortrix* (Linné)
Spreading adder; hog-nose

Rather infrequent. One which was plowed up October 3, 1928, lived in captivity until September, 1929. It refused to eat frogs and mice; on May 10, 1929, it ate two small toads (*Bufo woodhousii*). Another, collected by Dwight Johnson in July, 1929, seems rather restless in captivity.

27. *Heterodon nasicus* Baird and Girard
Spreading adder; hog-nose

Infrequent in collections. One was taken by Mr. and Mrs. A. E. Gilmore April 10, 1928, and has fed on bullfrogs about every three weeks except during the winter. Another collected August, 1929, by Dwight Johnson, has eaten toads.

28. *Opheodrys aestivus* (Linné)
Rough green-snake

Common in low grass, and bushes at the edge of wooded pastures. In captivity it feeds on small insects, especially grasshoppers. A group of 11 eggs, found by Mrs. A. E. Gilmore about August 1, 1928, in a rotted tree trunk, measured 15 mm. in length by 8 mm. in diameter. They were smooth, shiny and white and were fastened together in an upright position. On August 25, the young emerged from lengthwise slits. The average length of the young was 95 mm. Five eggs deposited July 17, 1929, by a female in captivity, averaged 25 mm. by 10 mm. One was opened every week during August. The last contained a deformed specimen which emerged unaided on August 26. Fifteen ventrals about ¼″ from the anal plate had grown back on each other so that the head was turned posteriorly by the looping process.

29. *Masticophis flagellum flagellum* (Shaw)
Coach-whip; whip-snake

Common on sunny slopes, under rocks and in brush piles. In captivity it is nervous and hard to handle, although it will readily eat mice, lizards, English sparrows, and even snakes of its own kind. Females under observation have deposited complements of 10, 11 and 16 eggs, from June 20 to July 10 (Table 1). On August 9, 1928, eleven eggs with embryos

TABLE I
COMPARISON OF SIZES OF EGGS AT TIME OF DEPOSITION BY MASTICOPHIS FLAGELLUM FLAGELLUM (SHAW)
Measurements made with vernier calipers

Date of deposition	July 7, 1927	June 30, 1928	July 10, 1928
Museum number	O. H. S. 384	W. J. H. 465b	W. J. H. 465a
Egg no.	Length×diameter	Length×diameter	Length×diameter
1	38.2×17.1 mm.	31.8×24.0 mm.	32.4×21 mm.
2	38.4×19.8 mm.	33.0×23.7 mm.	32.7×21 mm.
3	39.7×18.2 mm.	33.8×23.0 mm.	33.0×21 mm.
4	39.8×16.7 mm.	33.8×24.0 mm.	33.8×21 mm.
5	40.0×19.8 mm.	33.9×24.0 mm.	34.4×21 mm.
6	41.5×16.5 mm.	33.9×24.0 mm.	34.5×21 mm.
7	41.5×19.0 mm.	34.0×24.0 mm.	34.6×21 mm.
8	43.0×18.2 mm.	34.0×24.0 mm.	34.8×21 mm.
9	49.5×15.5 mm.	34.0×24.4 mm.	36.7×21 mm.
10	——	35.0×23.0 mm.	37.3×21 mm.
11	——	35.5×23.4 mm.	37.3×21 mm.
12	——	35.6×23.8 mm.	38.9×21 mm.
13	——	36.5×24.0 mm.	——
14	——	36.8×23.5 mm.	——
15	——	38.0×23.0 mm.	——
16	——	40.4×23.0 mm.	——
Total	9	16	12

Average number of eggs per brood, 12.3.
Average size of 37 eggs, 36.5×21.4 mm.
Extremes in length and diameter, 31.8 to 49.5 mm., and 15.5 to 24.4 mm.

measuring 205 mm. in total length, with a tail length of 55 mm., were dug from a potato hill. Considerable unabsorbed yolk was still attached. The squamation of one, W. J. H. 471, is as follows:

Scale rows	Ventrals	Caudals	Supra-labials	Infra-labials	Oculars	Tem-porals	Total length	Tail length
17-15	172	81	7	9	2.2	2-2-2	205 mm.	55 mm.

30. *Coluber constrictor flaviventris* (Say)
Blue-racer

Found abundantly from the last of March to the last of October. Habitat and food similar to that of the coach-whip. Hugh Davis reports finding a yellow-bellied blue-racer in a cardinal's nest. Mrs. A. E. Gilmore reports another in a red-winged blackbird's nest. It had eaten three eggs and had a fourth in the mouth. Four blue-racers retained in captivity have each deposited complements of 8 to 10 eggs between June 6 and July 9 (Table II).

31. *Elaphe obsoleta confinis* (Baird and Girard)
Spotted chicken-snake

In May and June occasionally found in brush piles, on tree limbs, or under rocks on sunny, wooded slopes. On October 25, 1925, one (O. H. S. 110) crawled out of a log which was being used for a camp fire.

TABLE II
COMPARISON OF THE SIZES OF EGGS AT THE TIME OF DEPOSITION BY COLUBER CONSTRICTOR FLAVIVENTRIS (SAY)
Measurements made with vernier calipers

Date of deposition	June 6, 1926	June 24, 1928	July 9, 1928
Museum number	O. H. S. 382	W. J. H. 408	A. E. G.
Egg no.	Length×diameter in mm.	Length×diameter in mm.	Length×diameter in mm.
1	31.8×13.6	29.0×14.2	31.0×16.0
2	34.7×12.8	30.0×14.2	31.0×16.0
3	35.4×15.5	30.0×14.2	31.0×16.0
4	35.5×16.9	30.0×14.2	31.0×16.0
5	36.4×17.9	30.0×14.2	31.0×16.0
6	38.0×13.7	32.0×14.0	31.0×16.0
7	38.0×16.5	32.0×14.1	34.0×16.0
8	39.8×18.0	34.0×16.4	36.0×15.0
9	——	37.0×13.5	39.0×16.0
Total	8	9	9

Average number of eggs per brood, 8.7.
Extremes in length and diameter, 29.0 to 39.8 mm., and 12.8 to 18.0 mm.
Average size of 26 eggs, 33.4×15.3 mm.

32. *Pituophis sayi* (Schlegel)
Bull-snake

Fairly common in the fields. Frequently reported as killed by autos on the highway. A six-foot individual has been a docile captive for five years. It eats small live mammals, lizards, English sparrows and occasionally dead animals if they are still warm.

33. *Lampropeltis calligaster* (Harlan)
Yellow-bellied king-snake

Most common king-snake of this region. It is found largely in prairie habitats, or in plowed fields. Two distinct color phases, dark and light, are exhibited by *Lampropeltis calligaster* in this region.

34. *Lampropeltis getulus holbrooki* (Stejneger)
Speckled king-snake

Occasionally collected. A female (O. H. S. 366), 322 mm. long, obtained from a brush pile in Okmulgee, Oklahoma, May 5, 1926, was kept for two months in captivity. On June 6, it ate two very young English sparrows, a fence swift (*Sceloporus undulatus*), and a small snake (*Tropidoclonion lineatum*). On June 15, it ate a race-runner (*Cnemidophorus sexlineatus*), and on June 26, a collared lizard (*Crotaphytus collaris*). This is in keeping with the observations of Hurter and others which show, in summary, the food to consist of mice, small birds, lizards, and snakes (Blanchard, 1921).

A set of eight eggs was deposited on June 2, between 4:45 and 9 P. M. The process was timed, and the results recorded in Table III.

In general the eggs were oblong, about twice as long as wide, with

TABLE III
TIME OF PROCESS OF DEPOSITION OF EGGS BY LAMPROPELTIS GETULUS HOLBROOKI (STEJNEGER)

Egg no.	Time of deposition	Time required in deposition	Time between each deposition
1	4:45 P.M.	——	——
2	5:30	——	45 minutes
3	6:35	2 min., 40 sec.	1 hour, 5 min.
4	7:11	2 minutes	36 minutes
5	7:26	2 minutes	15 minutes
6	8:00	2 minutes	34 minutes
7	8:40	2 min., 30 sec.	40 minutes
8	9:00	4 min., 30 sec.	20 minutes

TABLE IV
MEASUREMENTS OF EGGS OF LAMPROPELTIS GETULUS HOLBROOKI (STEJNEGER)
Measurements made with vernier calipers

Date of deposition	June 5	June 9
Egg no.	Length×diameter	Length×diameter
1	43.3×20.0 mm.	40.5×19.3 mm.
2	33.7×20.0	33.7×20.0
3	34.8×20.0	39.3×19.0
4	32.4×19.6	33.0×19.6
5	34.8×18.0	35.9×18.3
6	36.4×19.5	36.1×17.9
7	34.8×19.5	36.0×29.1
8	42.3×16.8	40.8×10.5

Average size of 16 eggs, 36.7×19.2 mm.
Extremes in length and diameter, 32.4 to 43.3 mm., and 10.5 to 29.1 mm.

parallel sides and rounded ends (Table IV). The first was somewhat larger and more irregular in shape than the others. The ends of each, soon after emergence, were a deep cream color, while toward the center they were almost white. The texture was smooth and parchment-like.

For several days before the egg deposition, the snake was extremely nervous and retiring, staying most of the time under a flat water pan in the cage. The deposition of the first egg was not observed. The second egg was laid under a tightly fitting tin tray of the cage. After the third egg, the snake lay very still for about 20 minutes, yet was apparently undisturbed when it was handled twice in an attempt to make photographs. Except for the turning of the tail under the body, there was very little movement in the deposition of the remainder. In this process the constriction of the body was very noticeable, forming a tightly compressed S-shape. After each deposition the body tension was greatly reduced. For the next two days the animal was very quiet, as if from exhaustion, but ate the food offered.

The eggs were kept in a covered pan of slightly damp, rotted wood. For six days there were occasional signs of rhythmic movements within the eggs, accompanied by a slight denting in on the sides. On the fourth day there were signs of molding and decay, which continued until the embryos had completely dried.

35. *Lampropeltis triangulum syspila* (Cope)
Red milk-snake

Rare. Only eight specimens have been seen by the writer in three years. The subspecies easily adapts itself to captivity and takes mice, lizards, and small snakes when offered.

36. *Lampropeltis triangulum amaura* (Cope)
Louisiana milk-snake

This subspecies is reported by Ortenburger (1926) from Tulsa County.

37. *Cemophora coccinea* (Blumenbach)
Scarlet-snake

Very rare. It has been reported only once before in the state (Ortenburger, 1926), on the specimen sent by the writer from Okmulgee County to the University of Michigan Museum of Zoology. A female and two juveniles collected in the spring of 1926 were sent to Dr. F. N. Blanchard, University of Michigan. A male collected by Billie Davidson, April 10, 1928, at Parthenia Park, Tulsa County, was kept alive until October 5, 1928. It refused to eat worms, insects, small mice, snakes and lizards. An attempt to feed it milk and eggs was also unsuccessful, owing to its tightly compressed, small mouth.

All these specimens were found hidden under large pieces of sandstone on rugged slopes, in the same habitat as were found king-snakes, blue-racers, coach-whips, ring-necks, tantillas and all types of skinks and lizards. One specimen was taken on the high bank of a little creek. In captivity, these snakes constantly burrowed in the dirt or wood pulp. The color pattern closely resembles that of the red milk-snake. The bands are of a brilliant red; the head itself is a whitish pink, and the belly is immaculately white, in contrast to the black checkered markings of the red milk-snake.

Total length of the female (O. H. S. 204) was 200 mm. and the tail 40 mm. The male (W. J. H. 85) measured 430 mm., and the tail 65 mm.

38. *Sonora semiannulata* Baird and Girard
Sonora; bicolored ground snake

About eighteen of these snakes have been collected in the last three years, between April 27 and May 24. They were found under limestone rocks at Lost City and in a limestone quarry east of Tulsa. Male, female, and immature specimens have been examined alive. A female (W. J. H. 179) was a uniform gray, with a faintly black neck ring. An immature specimen (W. J. H. 180), had 28 well marked dark bands. Others had from 21 to 29 bands; W. J. H. 713 was of a general tan color with two black bands, 3 scales wide, separated by a band of red, which half circled the neck. The labials and the ventral surface were light yellow. An immature specimen (W. J. H. 712), 122 mm. long, was of a general reddish color, with black on parietal, frontal, and supraoculars, with dorsal bands the entire length of the body; the interspaces were faintly darkened broken bands,with a median band of deeper pink. The belly was pearly white.

39. *Natrix grahamii* (Baird and Girard)
Graham's water-snake

Common from early in March until the middle of October, on the edges of creeks and in the mud of the bottom lands.

40. *Natrix rhombifera* (Hallowell)
Diamond-back water-snake

Common. Especially found in the Verdigris River bottom lands, ponds, and streams. September 7, 1929, a female belonging to Mrs. A. E. Gilmore gave birth to 43 young.

41. *Natrix sipedon sipedon* (Linné)
Common water-snake

Less common than *Natrix sipedon transversa.* It is found in a similar habitat and feeds in captivity like other forms of *Natrix.* A female collected by Hugh Davis near the Kiamichi River gave birth on August 23, 1929, to about 25 young, which were identified by Blanchard as this subspecies.

42. *Natrix sipedon transversa* (Hallowell)
Hallowell's water-snake

This subspecies and *Natrix grahamii* are the most common of the water snakes. They have been taken in the low swampy areas with *Natrix rhombifera.* The young are frequently found the last of August or early in September.

43. *Storeria dekayi* (Holbrook)
DeKay's snake

Occasionally taken on rocky hillsides, from under stones and in grassy, wet meadows from under boards. A female (W. J. H. 475) collected July 7, 1928, gave birth to 8 young August 13. Previous to deposition it stayed under a board in the cage. If earthworms were forced partly down the throat, they were eaten. In the process of deposition the female was very active, moving around and around the cage. The tail was held erect and the young emerged steadily, about 8 seconds apart. Each was in a fine tissue bag, which immediately burst. It remained attached to the ventrals but was shed almost immediately, before the little snake had moved about the cage three times. After the first nervous activity the young, together with the female, settled down under the water pan. The bands around the neck of the young were a bright yellow and the body color a rich brown like the female. The young measured 102 to 110 mm. in length, while the adult was 270 mm. in length.

44. *Virginia valeria elegans* (Kennicott)
Brown snake

Very rare. Two females collected in the fall of 1927 and April 28, 1928, extend the known northwestern range of this species (Blanchard,

1923). Neither individual had keeled scales. W. J. H. 153, collected in the fall, contained 12 ova from 2 to 4 mm. long and 1 to 3 mm. in diameter. The scale data follow:

Museum number	Locality	Date	Scale rows	Ventrals	Caudals	Supralabials
W. J. H. 153	Tulsa Co.	Fall, '27	17	120	25	6
W. J. H. 169	Lost City	4-28-'28	17	120	30	6

Infralabials	Oculars	Temporals	Anal	Total length	Tail length
5L 6R	0, 1L 1, 3R	0, 2L 1,2R	divided	245 mm.	30 mm.
7L 6R	0, 2L 3R	1L 3R	divided	240 mm.	35 mm.

45. *Potamophis striatulus* (Linné)
Ground snake

Occasionally found from March 4 until late fall in heavily wooded areas, under sandstone and limestone rocks. A female (W. J. H. 172), collected April 9, 1928, carried 4 large and 9 small ova in the anterior oviduct, and 2 large and 4 immature in the posterior oviduct. The larger ones averaged 5 and 6 mm. by 2 and 3 mm. Another (W. J. H. 177), collected March 3, 1928, contained 3 ova each and 1 to 3.5 mm. by 1 to 2 mm. in size.

46. *Tropidoclonion lineatum* (Hallowell)
Lined snake; striped snake

Most abundant small snake of the region. Usually found near dwellings under boards, tar paper, building blocks or tile. Females under observation brought forth living young between August 9 and 31. They ranged in number from 2 to 11, usually 7 to 9, averaging 120 mm. in length. They shed frequently and took earthworms the third day. The largest example the writer has recorded is 510 mm. long, but the usual size of the adults is 240 to 350 mm. The age and growth of this species has been made the subject of a separate paper (Blanchard and Force, 1930). Another contribution on the same species, on habits and birth of young, is scheduled to appear in the next number of COPEIA.

47. *Thamnophis sauritus proximus* (Say)
Ribbon-snake

Frequent in shallow ponds and water holes.

48. *Thamnophis sirtalis parietalis* (Say)
Red-sided garter-snake; red-barred garter-snake

Most common of the garter snakes from early February until late October. It is found both in low wet places and on rocky slopes. Specimens in captivity eat earthworms whenever they are proffered.

49. *Tantilla gracilis* Baird and Girard
Tantilla

Common on sandy, wooded slopes under rocks. Three females under

observation deposited 2 and 3 eggs respectively between June 22 and June 25. They were smooth in texture and irregular in shape. The color was ivory to yellowish white, with the germinal disk distinctly visible. They measured 15 to 24 mm. in length and 4.2 to 6.5 mm. in diameter. A female collected by Mrs. A. E. Gilmore laid one egg July 8 and a second July 11, of similar size, color, and texture. These beautiful little snakes are usually a rich brown above, with the head slightly darker. Below they are varying shades of salmon pink, except under the chin and the anterior end of the body and the ends of the ventrals, which are white. They are being made the subject of special observations.

50. *Agkistrodon mokasen* Beauvois
Copperhead

Occasionally recorded from the rocky, wooded bluffs and ridges of Tulsa, Rogers, and Osage counties. Live specimens have been taken at Parthenia Park and Turkey Mountain in May.

51. *Agkistrodon piscivorus* (Lacépède)
Cotton-mouth moccasin

One large specimen taken by A. E. Gilmore May 11, 1929, in the Verdigris River bottom. It is a very mild tempered captive. It eats bull-frogs about every three weeks, but refuses leopard frogs.

52. *Crotalus horridus* Linné
Banded rattlesnake; timber rattler

Occasionally killed in the hills. Two specimens from Osage County are in the collection of Mr. and Mrs. A. E. Gilmore. On September 29, 1929, a live specimen measuring about 6 feet in length was taken on the highway east of Tulsa by Mr. A. E. Gilmore.

TURTLES

53. *Sternotherus odoratus* (Latreille)
Musk-turtle

Fairly common. Four were collected June, 1929, in Osage County, by Gilmore.

54. *Kinosternon flavescens* (Agassiz)
Mud-turtle; yellow-necked mud-turtle

Mr. Gilmore collected one August, 1929, whose carapace measures 110×80 mm.

55. *Kinosternon subrubrum hippocrepis* (Gray)
Musk-turtle; mud-turtle

This species is reported by Ortenburger (1926) from Tulsa County.

A five inch specimen was taken in Prairie pond on May 18, 1929, by Mr. and Mrs. A. E. Gilmore.

56. *Chelydra serpentina* (Linné)
Common snapper; snapping turtle

Common in the ponds, creeks, and bottom lands, in sluggish water holes and coal pits.

57. *Terrapene carolina triunguis* (Agassiz)
Three-toed box-turtle

Occasional in heavily wooded, rocky areas.

58. *Terrapene ornata* (Agassiz)
Box-turtle

Common. A female, on July 14, 1926, deposited eggs among a group of other turtles. The only egg not eaten by them measured 35 by 21 mm.

59. *Pseudemys elegans* (Wied)
Red-eared turtle; slider; cooter

Occasional early in May at the margin of ponds or sluggish streams. The carapace of a specimen collected by Gilmore measures 155×115 mm.

60. *Amyda spinifera* (Le Sueur)
Spiny soft-shell

Occasional. In February, 1929, 22 individuals varying in size from 2 to 8 inches across the plastron were taken from the flats of the Arkansas River near Tulsa, by Jim Slack. On May 20, 1929, 32 round white eggs averaging 1¼ inches in diameter, were found in a female just killed. They were probably ready for deposition.

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Color Dimorphism in Graham's Watersnake, *Natrix grahamii* (Baird and Girard)

By J. E. GUTHRIE

ON July 15, 1928, the writer received from Mrs. Elinor Robson of Des Moines, Iowa, a living female specimen of Graham's watersnake, *Natrix grahamii* (Baird and Girard). The snake was taken by Mrs. Robson at a pond in one of the city parks.

In all available keys the determining of this species depends ultimately upon color characters. This specimen was unusual in that it lacked the expected white of the ventral surface and also the characteristic dark zigzag stripes where the ventral plates meet the lower row of dorsal scales. It was also without the narrow dark longitudinal lines higher up on the sides, and the midventral line or row of spots which the species usually exhibits over at least part of the body length. Following is the description: Length, 675 mm., tail, 130 mm., body width, 20 mm., head width, 10 mm., neck width, 9 mm., tip of head to rear end of parietals, 15 mm.; eyes, brown, prominent, 2.5 mm. in diameter. Scales, 19-17, gastrosteges, 158, urosteges, 54; anal plate, divided. Head, small and rather pointed; rostral, of medium height, dark. Loreal present. Internasals, 2. Supralabials, 7 (4th and 5th on left side incompletely divided, 5th and 6th largest, all dark); infralabials, 9, yellowish white.

General color uniform dark brown above, with a barely perceptible, slightly lighter median stripe about three scales wide bordered on each side by a slightly darker line about two scales wide. Ventral plates grayish, each with a transversely placed black border spot partly covered by the rear edge of the preceding plate, best marked toward the anterior end of the body. Spots continued back less noticeably on the urosteges. Median line of belly narrowly light yellowish; tail tip, acute. Very quiet and docile.

On September 12 this snake bore ten young, averaging about 216 mm. but ranging from 205 mm. to 230 mm. Of the ten young, four had the exact coloration of the mother, while the remaining six conformed to the color and pattern of typical *Natrix grahamii*. Of the dark ones, two were the shortest of the brood, measuring 205 mm. and 207 mm., respectively; while one measured 230 mm., making it the longest of all.

Are there other records of this color dimorphism in Graham's watersnake? Logier in COPEIA (No. 172, and 1930, No. 1) reports similar data on the color dimorphism of *Thamnophis s. sirtalis*.

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The Painted Box Turtle, *Terrapene ornata* (Agassiz), in Indiana

By Barton Warren Evermann and Howard Walton Clark

IN stocking up for the opening of the Steinhart Aquarium, there were received, May 21, 1923, from Mr. Russell V. Fisher of Culver, Indiana, among a shipment of turtles from the vicinity of Lake Maxinkuckee, two examples of the painted box turtle, *Terrapene ornata* (Agassiz). The receipt of these creatures from that locality caused some surprise, as, during a rather careful study by us of that region covering several years, not a single example of this species was found. Our first acquaintance with the species was derived from examples west of the Mississippi.

Original references to the species appear to be few and scattered. It was described by Agassiz in 1857 as *Cistudo ornata,* from the type locality of the Upper Missouri and Iowa. As to its region of greatest abundance, Hay quotes Cragin as saying that it is "so abundant in some sections of southern Kansas that it amounts to a nuisance as a cumberer of the ground."

So far as the records at hand go, the first reference to this species east of the Mississippi is that in Yarrow's Check-List of N. A. Reptilia and Batrachia (Bull. 24, U. S. Nat. Mus., 1882) which refers to 4 specimens from Illinois received from R. Kennicott (no date given) and 3 from Fairfield, Illinois, collected June, 1878, received from N. E. Roberts. The British Museum Catalogue (1889) gives the range as "Nebraska, Kansas, Iowa, Missouri, Illinois."

Most, if not all, of the published accounts of the occurrence of the species east of the Mississippi appear indeed to be based on these records in Yarrow's Check-List, as for example that of the British Museum catalogue given above. Hay, in his "Report on the Batrachians and Reptiles of the State of Indiana" (Seventeenth Indiana Geological Report, 1892), does not list the species for Indiana, but, commenting on the Fairfield, Ill., specimens referred to in the Yarrow Check-List, remarks that "its occurrence within Indiana territory may be discovered at any time."

As the box turtles drown readily when placed in water, the Mississippi at one time probably formed an impassable barrier between the two species, *carolina* and *ornata,* but the building of bridges would tend to remove this barrier. *T. carolina* has not yet been reported west of the Mississippi, but at Muscatine, Iowa, where a bridge crosses that river, one *ornata* was captured about 1922 by Dr. A. D. Howard, then a scientific assistant at the U. S. Bureau of Fisheries Biological Station at Fairport, Iowa.

According to Bauer, who transferred *ornata* to the genus *Terrapene* (Science, Ser. 1, 17, 1891: 191), it is the most highly differentiated species of the genus. Even when young it lacks the dorsal keel which is present in its relative *carolina,* and is generally more pronounced in the young

of turtles, becoming obscured with age. In coloration and color pattern *T. ornata* is much more stabilized than *T. carolina;* no two examples of *carolina* are marked alike, a feature that lends more variety to that species, though *ornata* is generally regarded as the more attractive. The color markings of the plastron of *carolina* are also variable, there being no definite color-pattern, but the color ranges from clear horn-color to uniform brown or black. In *ornata* the plastron is always marked with a beautiful rug-like pattern, and this furnishes the easiest way to distinguish the species. *T. ornata* does not reach nearly as large a size as *carolina.*

However *ornata* may have reached Indiana, it appears to be now fairly well established about Lake Maxinkuckee. Six or seven specimens have been received by us from there, from time to time since 1923. On a visit to Lake Maxinkuckee in June, 1924, Mr. Clark obtained a shell west of the lake and a living one was captured. The species was already, indeed, becoming as familiar an object about Lake Maxinkuckee as *T. carolina.*

We have then, in the case of *T. ornata,* an invasion eastward of a species into the territory of a rather closely related species, made possible, perhaps by the removal in restricted localities of the barrier of rivers by the building of bridges. The reported excessive abundance of *ornata* in certain localities would indicate that its reproductive capacity or its survival coefficient is greatly superior to that of *carolina* which is generally represented, even in favorable localities, only by scattered individuals.

Whether hybridization will take place, or the newcomer displace the older resident, furnishes a situation to be watched with interest.

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The Amphibians and Reptiles of Bryce Canyon National Park, Utah[1]

By Vasco M. Tanner

Bryce Canyon, our twentieth national park, is located in Garfield County, Utah, about twenty miles southeast of Panguitch, and about sixty miles north of the Utah-Arizona state line. The Canyon has been carved from the Paunsaugunt Plateau which has an elevation of over 8,000 feet. From the west rim of the plateau at the Lodge area to the east boundary line of the park, a distance of three miles, there is a drop in elevation of about 1500 feet. There are no permanent streams within several miles of the Lodge. The water from the winter snows and the summer rains does the erosive work.

The plateau area is beautifully wooded. The forest trees, noticeable

[1] Contribution No. 22 from the Zoological Laboratories of the Brigham Young University, Provo, Utah.

shrubs, and flowers that may be encountered within a mile of the Lodge are: Rocky Mountain yellow pine, *Pinus scopulorum* Lemmon; limber pine, *Pinus flexilis* James; bristlecone pine, *Pinus aristata* Engelm.; pinyon pine, *Pinus edulis* Engelm.; Douglas-fir, *Pseudotsuga mucronata* (Raf.) Sudw.; white fir, *Abies concolor* Lindl.; alpine fir, *Abies lasiocarpa* (Hook.) Nutt.; red cedar, *Juniperus scopulorum* Sarg.; mountain juniper, *Juniperus sibirica* Burgsd.; manzanita, *Arctostaphylos platyphylla* (A. Grey); bitter bush, *Purshia tridentata* (Pursh); rabbit-brush, *Chrysothamnus* sp?; aster, *Aster adscendens* Lindl.; and pentstemon, *Pentstemon coloradensis* A. Nels. In the canyon and along the east boundary line of the park may be found the Utah oak, *Quercus utahensis* (A. DC.); manzanita; willows, *Salix spp.;* birch, *Betula fontinalis* Sarg.; cottonwood, *Populus angustifolia* James; aspen, *Populus aurea* Tidest.; and clematis, *Clematis* sp.? A small spring rises from the south wall of the canyon a short distance below the east boundary of the park. Within this situation the following amphibians and reptiles were obtained. Other species may be found, but the list below represents all that have been observed by the Park officials and that have been taken by the writer during several days collecting in August, 1922, July, 1927, and August, 1929.

Amphibians

1. *Ambystoma tigrinum* (Green)

Tiger salamander

The writer collected adult specimens of this species in a garbage pit on the public camp grounds, August 27, 1929. Just where this water-loving species breeds in this dry locality is a puzzle, since there are no ponds or streams within several miles of the camp grounds. The individuals captured in the pit seem to be thriving on the garbage.

2. *Scaphiopus hammondii* Baird

Western spadefoot toad

This interesting nocturnal species was collected in July, 1927, by Anson Call, Jr., and the writer. It had been raining for several days and was muddy along the rim of the canyon. At night as we went about with our flashlights we captured two specimens.

Reptiles

3. *Sceloporus graciosus graciosus* (B. & G.)

Sage-brush swift

Several specimens of this common lizard were collected in the canyon in August, 1929. They were rather numerous in the oaks and manzanita. The stomach contents of five specimens revealed that they were feeding upon a locustid of the subfamily Tryxalinae.

4. *Phrynosoma douglassi ornatissimum* (Girard)
Girard's horned lizard

This harmless lizard is rather common on the plateau. It is well protected by its distinctly reddish and blue color. The assistant park naturalist, Mr. R. B. McAllister, collected one in July and I collected several in August, 1922, and 1929.

5. *Cnemidophorus tessellatus tessellatus* (Say)
Desert whiptail lizard

Specimens of this species were taken in the Canyon in August, 1929. It has never been taken or observed on the rim of the Canyon near the Lodge.

6. *Thamnophis ordinoides vagrans* (B. & G.)
Wandering garter-snake

A single specimen of this widely distributed species was captured near the eastern boundary of the park. It is not common in the park. The specimen had just eaten a nest of five deer mice.

7. *Crotalus confluentus lutosus* Klauber
Great basin rattlesnake

Mr. McAllister captured a half grown rattlesnake in July, 1929, in the Canyon near the eastern boundary line. It is rarely met with in the canyons of the Park. This venomous snake has never been found on the Lodge area of the Plateau. The specimen herein reported was recently studied by Mr. L. M. Klauber, and this locality listed by him on page 102 of his paper.

According to the distribution of *lutosus* and *Crotalus confluentus concolor* Woodbury, as pointed out by Mr. Klauber, this specimen was taken on the border line between the two subspecies. A number of interesting problems present themselves in connection with the rattlesnakes of San Juan County, Utah.

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An Extension of the Range of *Coluber constrictor mormon* (Baird and Girard)

By L. C. Stuart

Ortenburger (Mem. Univ. Mich. Mus., Vol. I, 1928, 219), in defining the range of *Coluber constrtictor mormon,* states that it extends "from the Pacific Ocean east to the Rocky Mountains." Recently, in checking over the specimens of this form in the collection of the Museum of Zoology, University of Michigan, the writer found a specimen which extends the range of this subspecies along its northeastern border. The specimen, No. 64,945, was collected by Carl L. Hubbs and L. P. Schultz on June 12, 1926, "8 miles E. of Bigtimber, Montana," and was taken after Ortenburger had completed his examination of specimens. Of the material recorded by Ortenburger, the specimen closest to this locality was taken some 200 miles to the southwest, at a point about 50 miles west of Idaho Falls, Idaho, and at a distance of over 350 miles from the nearest record of *Coluber constrictor flaviventris* (Say). Thus in the north these two subspecies have, through this new record, been brought to within approximately 130 miles of each other.

Ortenburger (p. 225) further states that, since the higher portions of the Rocky Mountains are uninhabited by this form, "it is possible that the Rocky Mountains may have served as an effective barrier to the migration of these racers" (*mormon*). This conclusion may now be questioned, although it is possible that this western form may have crossed the main range further to the south, where, as pointed out by Ortenburger (p. 228), there are no high mountain barriers, and from this point migrated northward on the eastern side of the range. Further records alone can settle the verity of these two possibilities.

The description of the specimen mentioned above follows: Scutellation, dorsals 17-15, ventrals 166, caudals 63+ (an inch or more of the tail missing), anal divided, supralabials 8, infralabials 8, preoculars 3 (caused by a horizontal division of the upper one), postoculars 2, temporals 2+2+2, loreals 2 (caused by a horizontal division). Dentition, maxillaries 13, mandibulars 16. Body length 723 mm., tail length 198+ mm., total length 921+ mm. Coloration in alcohol, olive green above, bright cream-yellow below. Sex, female; the right ovary with four ova and the left with three.

This specimen is particularly interesting not only because it has extended the range of this form, but also because it is the first record of this subspecies in Montana. Furthermore, despite its proximity to the other subspecies (*flaviventris*), no evidence of intergradation is manifested in this specimen. The labial scutellation is typically that of *Coluber constrictor mormon* (Baird and Girard), as is the dentition. The remaining characters of the two forms so overlap that they are of little value in determining taxonomic status.

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Notes on the Food of the American Toad

By W. J. Hamilton, Jr.

While considerable has been written upon the food of *Bufo americanus,* most writers have dealt with mature toads only. The present note pertains only to immature forms, ranging in length from 8 to 12 mm. During June, July and early August of 1928 and June of 1929, I have taken and examined 400 of these small toads. However, no criteria of the food predilection as exercised by any animal can be accurately judged from a large number taken in the same place at the same time. If several hundred small toads are taken from the shelter of a manure pile, one would expect to find 90 per cent or more of the food consisting of a single item, i.e., manure fly larvae, *Ceratopogon* and *Leptocera.* Accordingly, not more than fifty individuals were taken on the same date, and these were taken as widely scattered as possible.

The toads examined seldom had more than six species of animals in their stomachs, and more often than not, a few mites, thrips or insect larvae made up the total. Rarely a stomach would contain over a dozen different arthropods. The food is recorded in percentage by bulk, and follows in the order of abundance.

Diptera made up 22 per cent. of all the food taken. The larvae were far more abundant than the adults. Small forms are favored. Mites appeared next in abundance, comprising 15.5 per cent. Several genera were recognized, and more than 80 per cent. of the stomachs contained these arthropods. Several toads had more than 40 mites in their stomachs and one had eaten 77. Ants were taken avidly and comprised 12.8 per cent. Beetles and their larvae, the latter the more abundant, constituted 11.8 per cent. The most abundant of the Coleoptera appeared to be staphylinids. Thrips formed 10.1 per cent. of the food, but were found in all but a few stomachs. These small insects appear to be a staple article of diet for young *Bufo.*

Collembola comprised 6.2 per cent. of the diet. The springtails sometimes occurred in large numbers in the stomachs examined, and together with thrips, appeared to be an important food of all small anurans. Insects and their larvae of the orders Lepidoptera and Hymenoptera (excepting ants), and aphids, sowbugs, spiders, worms and small snails, all in about equal numbers, comprised 12.1 per cent. Undetermined insect remains made up 4.4 per cent., while the remaining 4.6 per cent. consisted of such extraneous matter as dirt, grasses, small pebbles and little pieces of wood.

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A Record of *Polyprion americanus* (Bloch and Schneider) from the Northwestern Atlantic

By William C. Schroeder

A SMALL specimen of the wreck-fish (*Polyprion americanus*) has been received by the Museum of Comparative Zoology, Cambridge, Massachusetts, from Dr. A. H. Leim, Director of the Fisheries Experimental Station, at Halifax, Nova Scotia, who in turn received it from W. C. Smith & Co., Ltd., of Lunenberg. The fish was found by Capt. Newman Wharton of the *Jean and Shirley,* under a piece of floating wreckage, on the southern part of the Grand Bank, in Lat. 44° 50′ N., Long. 50° 20′ W., early in August, 1929.

This record appears to be only the third for the northwestern Atlantic:[1] the previous ones are of a small fish taken on the Grand Bank about 1880, by a Gloucester fishing vessel, and another about 10 inches long taken with hook and line, 8 miles off Asbury Park, New Jersey, in August, 1910, and recorded by Dr. R. C. Osburn in the Bulletin of the New York Zoölogical Society for November, 1910. A fourth record from the eastern American coast is that of Cuvier and Valenciennes (1831: 475) who mention a specimen about 2 feet long from the mouth of the La Plata River, given by fishermen to M. d'Orbigny.

Other locality records of this fish, besides those from America just mentioned, include Europe from Norway to the Mediterranean; Madeira and Canary Islands; Cape of Good Hope and the southern Indian Ocean (St. Pauls Island: Lat. 38° 43′ S., Long. 77° 38′ E.).

The wreck-fish appears to be most plentiful in the Mediterranean and neighboring parts of the Atlantic, especially around Madeira, where Lowe (1843-60: 183-189) speaks of it as one of the commonest and best known fishes in the market. There it is called Shern or Sherny. Describing its capture Lowe writes: "The Sherny in Madeira is only captured by the hook; and though shoals of small fishes, weighing from five to twenty pounds, and called Chernotta, are said to be often taken near the surface, in the neighborhood of floating wreck or logs of wood, the proper habitat of the full-sized fish, weighing from thirty to one hundred pounds, is from one to two or three leagues from shore, and at the enormous depth of from twelve to fifteen or sixteen *linhas,* or from three hundred to four hundred fathoms. With a strong line of this length, to the bottom of which is tied a stone (called the "pendula") of three or four pounds' weight, and having attached immediately above the stone, at intervals of eighteen inches, from twelve to fifteen strong hooks, baited with pieces of Cavallo (Mackerel) or Chicharro (Madeiran Horse-Mackerel), I have frequently assisted at

[1] Another species, P. prognathus, is known from the South Pacific. Day (1880-84: 18) erroneously recorded it from "Queen Charlottes Isle on the western shores of North America" on the strength of Forster's (1844: 309) record of Perca prognathus but the latter actually obtained his specimen at New Caledonia, where he gave its habitat as "Aestuario Reginae Charlottae" and probably referred to a small bay in the vicinity of Cape Queen Charlotte.

the capture." Each boat is generally furnished with two such lines, each worked by a single fisherman who is, however, assisted by others in the labour of hauling in the line, which takes from twenty to thirty minutes.

Cuvier and Valenciennes (1829: 21) describe it as common in the Mediterranean, and as a food fish there of some importance, a statement repeated by Couch (1862: 200). Moreau says it is taken at Nice the year around, but that it is rare at Cette. It is well known in the Bay of Biscay, according to Moreau (1881: 353) who states that it occasionally runs up the Gironde River, and often comes to market at Bayonne. North of the latter region it apparently is not plentiful enough to be a market fish.

On the south and west coasts of the British Isles, Couch (1862: 200) says it is well known to the fishermen. In this locality, although it may not be seen for several years at a time, a large number of them are often found to accompany wreckage driven in from the direction of the Atlantic. Couch continues—"So familiar is the opinion that such a mass of floating wreck in the northern part of the Atlantic is usually accompanied with a multitude of these fishes, that I am informed, when it floats within sight of a ship and the weather is favourable, a boat is often sent with the expectation to obtain some of them, which is done by piercing them with a spear usually employed by sailors for such an object, under the name of grayns. So many as thirty-five have been secured at one time by a single boat on our coast."

In Scandinavian waters, where Smitt (1892: 48) records a 12-inch specimen taken at Solvig, 13 miles from Bergen, in July, 1843, the fish is apparently rare.

The wreck-fish attains a large size. The habits of the smaller fish differ from those of the larger, for while virtually all those observed near the surface are relatively small and often in schools, many of those taken from deep water are large, and leading a solitary existence. Couch, who saw a considerable number around the British Isles, noted that only one exceeded 20 pounds. From the Mediterranean, where large fish occur in deep water, Moreau mentions one of 1.40 meters, in the Marseilles museum. At Madeira, Lowe, speaking of the ones caught in deep water, states that "The usual size of these was from two and a half to three and a half feet long, weighing from twenty-five to forty or fifty pounds. Fishes from fifty to a hundred pounds in weight are, however, by no means exceeding uncommon; but they are rarely seen of greater size."

The little specimen at hand agrees very well with the description given by Boulenger (1895: 150), and as there is but one species known in the North Atlantic, and this easily recognized, a detailed account of the present fish need not be given. Measurements in millimeters were as follows: Total length 150; standard length 126; depth 53; caudal peduncle 21; head 49; eye 10; interorbital 17; premaxillary 21; mandible 30. Dorsal XI, 11; anal III, 9; ventral I, 5; pectoral 18. Branchiostegals 7; gill-rakers 8 on lower first limb, plus 7 rudiments. Color in alcohol, mottled grayish on a cream ground.

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A Selachian Clasper with a Hundred Hooks

By PETER J. SCHMIDT

THE claspers of the males of selachians, derived from a part of the ventral fins and functioning as organs for copulation, are sometimes of a very complicated structure. They show different devices for fastening onto and holding the female. Perhaps the most strange and wonderful construction of any clasper was found by me in a Japanese shark, which was described in 1908 almost simultaneously by Tanaka as *Catulus torazame,* and by Pietschmann as *Scylliorhinus rudis.* Tanaka's name apparently has slight priority, and the species may be known as *Halaelurus torazame* (Tanaka). The species was referred by Garman (1913) to *Catulus,* but that generic name although the oldest for the group, is preoccupied; the name *Scyliorhinus* of Blainville therefore becomes available for the same group; it has priority over *Scyllium* Cuvier, a third name with the same restricted type, *Squalus canicula* Linnaeus. Tanaka in 1911 referred the species to *Halaelurus,* and it seems to me that it is really a *Halaelurus* because of the structure of the labial folds and of the nasal valves, which are very different from those of *Scyliorhinus canicula* Linnaeus. It is near *Halaelurus burgeri* Müller and Henle, which has also quite rudimentary labial folds.

The peculiar structure of the clasper of *Halaelurus torazame,* its large scales and the posterior position of the first dorsal fin, may eventually be

taken as indicating its generic distinctness from either *Halaelurus* or *Scyliorhinus*.

The claspers of the male of this shark were described and figured by Pietschmann,[1] but his figure shows only the external view. The interesting internal structure was overlooked by the Austrian ichthyologist. This species is not treated by Leigh-Sharpe in his memoir[2] on the claspers of various species of "Scyllium," nor in his previous memoirs in the same series. Having found in my collection two mature males, I was able to make a thorough study of them.

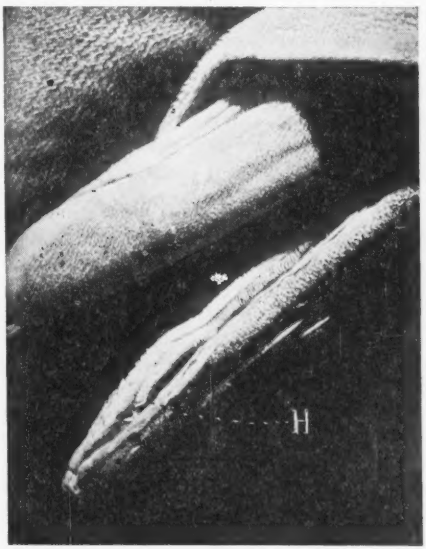

Fig. 1

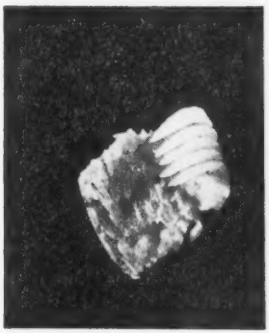

Fig. 2

Fig. 3

Figures 1 to 3. Clasper and clasper hooks of *Halaelurus torazame*. For explanation see text.

The claspers are comparatively large: in a shark of 402 mm. total length, they are 60.0 mm. long, and project slightly beyond the tips of the coalescent ventral fins, which envelop both claspers and form a kind of preputium. Each clasper is subcylindrical, compressed and conical to the end; it is covered with small, smooth scales. On the dorsal side it is cleft along the whole length, to form a deep gutter with contiguous borders (Fig. 1). Inside, on the external border of this gutter, we find a dense row of hooks, which are closely aligned one against the other, and extend without interruption from the tip of the clasper to its base. Their sharp ends are directed externally. These hooks morphologically are nothing else

[1] Sitz. Akad. Wiss. Wien, Math. Nat. Kl., 117, 1908: 703, fig. 10.
[2] Jour. Morph. and Physiol., 42, 1926: 321-331, figs. 1-8.

of course than specialized placoid scales; they have a slightly enlarged base (Fig. 2) and are 1.0 mm. long from the base to the arch and about 2.0 mm. long if measured along the curve (Fig. 3). They are difficult to count accurately, but by approximate estimation (measuring the distance occupied by 10 hooks, and the whole length of the row), one can see that there are not fewer than 100, perhaps a few more.

Considering now what purpose this arrangement can serve, one comes to the conviction that the hooks can be used only for fastening the clasper on the wall of the vaginal part of the oviduct of the female during the copulation. Probably, when the clasper is introduced, the borders of its gutter are turned out and all the hundred hooks of the row are imbedded in the oviducal wall, holding the clasper as anchors. If the other clasper is introduced simultaneously in the other oviduct, the male is held by 200 little anchors. This arrangement may be necessary, as the female of this shark is larger than the male, which is perhaps carried about by the female during a copulation that may continue for a very long time.

This arrangement of the organs of copulation of the male seems to be unique not only among the fishes, but perhaps in the whole animal kingdom.

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John N. Cobb, Dean of the College of Fisheries

By Leonard P. Schultz

THE death of John N. Cobb, dean of the College of Fisheries, University of Washington, Seattle, has deprived the fishing industry of a friend and educator. His death occurred on January 13 of this year, at La Jolla, California, after an illness of many months, at an age of sixty-one years.

Dean Cobb was born in New Jersey. He entered the Bureau of Fisheries as field agent in 1895, gathering data on the fisheries of the Great Lakes and Atlantic states. He made an investigation of the Hawaiian fisheries in 1901 and 1904. He was appointed assistant agent in charge of Alaska fisheries in 1904. In 1912 he left the government service and became Editor of the Pacific Fisherman, until his appointment as Assistant General Superintendent of the Alaska Packers Association in 1917.

Upon the establishment of the College of Fisheries at the University of Washington in 1919, John N. Cobb was called as its Director, which title was later changed to Dean. The success, value, and constructiveness of his work at the University has been widely recognized by the fishing industry. Only those closely associated with his work fully appreciate the concentration and unremitting effort that marked his career, or the earnestness with which his life was devoted to the development of the college along technological lines. It is doubtful whether any other man at this

time had as wide a knowledge of all aspects of the fisheries and fishery industries as was possessed by Dean Cobb, who occupied a unique position in the educational field as dean of the only college of fisheries in America.

Dean Cobb as author contributed much information on the cod, salmon, shad, lobster, and sponge fisheries. He produced a number of articles of widely recognized importance, among which may be mentioned his "Pacific Cod Fisheries" and "Pacific Salmon Fisheries," and also two books, one (with Evelene Spencer) on "Fish Cookery," and "The Canning of Fishery Products." John N. Cobb will be remembered as an educator, and student of the fishing industry. His career as such has been most fruitful, and his loss is mourned by his many students and friends at the University.

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Abstracts of Some of the Papers Read at the New York Meeting

THE EGGS OF *PSEUDOBRANCHUS*.—Among a series of *Pseudobranchus striatus* which I collected at Lakeland, Georgia, February 23, 1930, there was one female which has deposited eggs in the laboratory during March and April. The female was kept in a crystalizing dish 25 cm. in diameter with two apparent males and a small clump of water hyacinths. Although the eggs of *Pseudobranchus* have been previously reported, no detailed description has been given.

The female, which was 141 mm. in total length, laid five eggs March 3, one egg March 31, three eggs April 2 and two eggs April 11. The eggs were laid either singly or attached in pairs. The outer capsule of each single egg and of one of each pair, was attached without a stalk to either the bottom of the dish or the hyacinth roots. The body of the female was only 5.5 mm. in greatest diameter. The greater diameter of the fresh egg with its capsules was 5 mm. The egg alone measured 3 mm. in greatest diameter and was well pigmented for about two-thirds of its surface. There were two capsules and a well marked vitelline membrane. The outer capsule measured approximately 0.5 mm. in thickness and was more opaque, that is, whiter than the inner capsule. It was also very adhesive in these freshly laid eggs. The middle capsule measured 4.5 mm. in diameter, the vitelline membrane 3.8 mm. in its normal position surrounding the egg. One of the eggs laid April 2 showed three or four cleavage furrows. Unfortunately the eggs laid this date were devoured by the adults. None of the other eggs showed definite evidence of development and may in fact not have been fertilized. In addition to the five eggs laid March 3, five empty egg capsules were found in the dish. It was clear from the subsequent observation that either the female or the males had eaten the eggs previously contained in these capsules. Thus, *Pseudobranchus* lays from one to ten eggs at a time and these are scattered over the bottom of ponds or attached to water weed. The sticky outer capsule of each egg serves to fix the egg to any object with which it comes in contact at the time of laying.—G. K. Noble, *American Museum of Natural History, New York.*

INCUBATION PERIOD OF *HEMIDACTYLUS BROOKI* GRAY AND *SPHAERODACTYLUS DIFFICILIS* BARBOUR.—The adults of these two species were kept in a 28-30° C incubator in the laboratory. Their eggs were maintained in a 26-28° C incubator, each egg dated and partially buried in a 'Woods Hole' dish filled with loose, slightly dampened wood pulp.

Hemidactylus brooki eggs have been collected in November, December and January in Samaná, Dominican Republic, and were laid in the laboratory during January, February, March and the first half of April. Thirteen eggs laid in the incubator hatched in an average of 64 days, the lower extreme being 57 and the upper 69 days. Two eggs laid *en route* from Samaná in November, hatched in 82 and 85 days. This longer period is undoubtedly due to the chill undergone by the eggs on shipboard.

Sphaerodactylus difficilis eggs have been collected in November and December in Samaná, and laying in the laboratory occurred only in these months. One egg of this species, laid in the incubator, hatched in 54 days. Two others laid *en route* from Samaná in November, hatched in 66 and 67 days. This longer period is probably due to the chill undergone by the eggs on shipboard.—H. K. Teale, *American Museum of Natural History, New York.*

THE COURTSHIP OF THE PLETHODONTID SALAMANDERS.—We have studied the courtship of a series of plethodontid salamanders, in the dark room, using a red light for illumination. A variety of receptacles and temperatures were used in making the observations. Courtship behavior in the following forms was observed during the past year: *Eurycea bislineata bislineata, E. b. cirrigera, E. gutto-lineata, Manculus quadridigitatus quadridigitatus, Desmognathus fuscus auriculatus, D. f.*

fuscus, D. phoca, D. quadra-maculatus, Stereochilus marginatum, Plethodon glutinosus, P. cinereus, Hemidactylium scutatum, Hydromantes genei, H. italicus. Because large series were available, observations on *Eurycea b. cirrigera* and *Stereochilus* are the most detailed. The general pattern of courtship is essentially the same in all these species even though some are aquatic and some are terrestrial. In all species, so far as determined, there is a series of preliminary rubbing movements during which the male applies his lips, cheeks, mental gland, or side of body to the snout of the female. This arouses the female's interest in the male. In the second phase of the courtship, the female follows the male, keeping her chin pressed closely against his tail base as they move about the tank. The male, especially when he is not moving forward, undulates the base of his tail from side to side. Side to side movement of the head of the female, previously reported for *Eurycea b. bislineata* by Noble, 1929, occurs mainly in the case of small females with comparatively short legs.

At the height of the courtship, after the female has assumed her position behind the male, the latter often turns and pushes the female in the cloacal region with his nose. This causes the pair to move in circles about the aquarium. Another posture and movement not previously reported is the lifting of the body and arching of the tail of the male while the female is following him. This may tend to raise the fore part of the female from the floor. Another peculiar attitude during the same period is the turning forward of the tail of the female in some species, particularly in *Eurycea b. cirrigera* and *Stereochilus.* Still another distinctive position, noted especially in *Stereochilus* and *Hydromantes,* is the forcing of the mental glands tightly over the nostrils of the female while the male maintains a position directly over her back. Some of these poses may be characteristic of certain species and will be described in detail in the full report.

We attempted to cross some of the forms. Actively courting pairs were switched. It was found, however, that the male would soon lose interest in the foreign female, after the preliminary nosing phases. In crosses of *Stereochilus*× *Eurycea* and *Stereochilus* × *Desmognathus,* the preliminary activities terminated very quickly. In crosses of *Desmognathus f. auriculatus* × *D. phoca, D. phoca* × *D. quadra-maculatus* and *D. f. auriculatus* × *D. quadra-maculatus,* the interest of the male in the foreign female was slightly more sustained, but never advanced beyond the preliminary courtship phases. We found, however, that *Eurycea b. bislineata* from Long Island, and *E. b. cirrigera* from North Carolina, would court together readily, although the animals differed greatly in superficial aspect. We may conclude that there is a specific odor in the skin of the females which repels males of a different species and prevents cross matings. On the other hand, animals merely differing subspecifically are not incompatible and readily court.

Even though all these plethodontids have distinctive hedonic glands in the skin of the male which serve as a source of attraction for the female, nevertheless, this attraction cannot be exerted unless the female is sufficiently stimulated by the caressing movements of the male. Crushed hedonic glands or male skin treated with pilocarpine, failed to induce following reactions in females which had not been courted. Although many records were made of the courtship of the plethodontids listed above, in no case were spermatophores actually seen to be deposited. The bases of spermatophores were found in the tanks after *Eurycea b. cirrigera* had been courting, and spermatophore heads were found in the cloacas of *Stereochilus* females after courtship. In some species the courtship was not very extensive; thus, we have observed only part of the procedures in *Plethodon.* We obtained the spermatophore of *Hydromantes genei.* This was deposited on top of a damp flower pot. It resembled the spermatophores of *Eurycea* but was much larger and had less gelatinous material forming the base. Further, we have many records of courtship activity on the part of the males of this species. We have observed them astride females for extended periods, pressing their mental pads over the nostrils of the females. But we have never seen the females follow the males as is the case with other plethodontids. Whether this was due to the failure of the females to exhibit sexual activity or whether this performance is not a part of the *Hydromantes* courtship pattern, we are at present unable to say.

It is interesting that in *Hydromantes platycephalus* all the teeth in the upper jaw are greatly elongated and monocuspid. The courtship in this species is unknown, but

if it proceeds as in other species of the genus, this modification may be correlated with the greater use of rubbing movements in stimulating the female to pick up the spermatophores.—G. K. NOBLE and M. K. BRADY, *American Museum of Natural History, New York.*

THE COURTSHIP OF SOME IGUANID AND TEIID LIZARDS.—The courtship and mating of *Eumeces fasciatus, Leiocephalus schreibersi, Anolis sagrei, A. cybotes, Sceloporus undulatus, Cnemidophorus sexlineatus* and *Ameiva chrysolaema* have been studied by us in the laboratory. Courtship activity develops in the males whether or not any females are present. In *E. fasciatus* the male attempts to bite the side of the neck of other adults whether male or female. Non-courting or fighting males of this species usually attack the head of their opponents, but courting males snap at the neck. *Ameiva chrysolaema,* which exhibits only a slight difference in color in the male, begins his courtship very much as does *Eumeces,* but usually the male only pokes the back of the neck of an adjacent lizard. The courting male endeavors to maintain his position on the back of his partner, which moves rapidly about in an effort to escape. Males of *L. schreibersi* compress their bodies, exposing their bright red stripes. This happens most frequently when courting males are fighting. Their bodies are greatly extended in a ventral direction, the legs are held stiff and the tongue is arched and thrust well out of the mouth. The courting males move sideways towards other males warningly, rocking back and forth in a fore and aft direction. They frequently spring forward and attempt to seize with their teeth adjacent males in the neck region. If the attacked lizard does not fight back, the attitude is less ferocious and the grip is less forceful. The posture of the courting *Sceloporus* is less grotesque than that of *Leiocephalus,* but it has the same result of exposing the bright colors of the male to the best advantage. The forepart of the body is raised by straightening the forelimbs, the body is compressed and then bobbed up and down. This bobbing is not to be confused with the head nodding characteristic of both iguanid and agamid lizards and practiced by both sexes and by juveniles. The head nodding attracts attention and may serve to keep the colonies together. The males of the two anoles advertise their sex by spreading their throat fan. *A. cybotes* and *L. schreibersi* also erect their low dorsal crests.

That the females play no rôle in inducing the males to court, was shown most clearly by *A. chrysolaema.* The beginnings of twenty-nine of the forty-eight courtships were witnessed, and in each case the male rubbed his cloaca laterally over the stones or some other object before looking about for a possible mate. Vibratory movements of the tail were noticed in the two beginnings of courtship witnessed in *E. fasciatus.* In these two cases the courting males were directing their efforts toward other males.

The females of all the species studied except *S. undulatus* normally endeavor to avoid the courting males. In this species the female shows a willingness to mate by hopping around with hunched back and slightly bent limbs. This crouched posture and movement stands in striking contrast to the normal locomotor movements of the males or of the females. The crouched female may hop about keeping her hind quarters directed towards a courting male. However, other females hunch their backs and hop when no males are active, showing that this movement of the female is not a direct response to the courting of the male. In no other lizard have similar courtship movements in the female been noted, although in one female of *L. schreibersi* a somewhat similar posture was once assumed during a courtship.

Sex recognition is accomplished by the differential responses or displays of other lizards to a courting male. Where lizards such as *A. chrysolaema* are of nearly the same color in both sexes, differential response alone enters into sex recognition, the female showing less resistance to a courting male. This was well shown in one observation, in which a courting male *A. chrysolaema* mated with a sleeping male of the same species and then, tired by his efforts, quieted down and was immediately seized by the awakened lizard and forced to play the rôle of a female in a second mating. In other cases where both sexes were present in the cage with a courting *A. chrysolaema,* no definite choice was made at the beginning of courtship. In twelve courtships the male courted alternately both sexes; in two, he courted only males, and in four only

females. In five completed matings of the two species of *Anolis* recorded, two were with other males. In one of the latter cases the male playing the rôle of female was sick and apparently had not the vigor to fight off the courting male. In the other case the male functioning as a female was healthy but remained passive and failed to display his throat fan on the approach of the courting male. In four of the thirteen recorded courtships of *Leiocephalus*, the male attempted first to mate with a smaller male. Thus, the incidence of males mating with other males, even to the point of shedding sperm in the cloaca of the partner, is very high in lizards. Any characters, such as greater muscularity in the male, or brighter colors which would advertise their sex, should tend to avoid useless matings and hence would be conserved by natural selection. Dewlaps and bright colors in the male serve thus as warning mechanisms to other courting males. The fights between the males of *Leiocephalus* are often matches of display, while those of *Eumeces* are obviously matches of strength. Hence, natural selection would tend on one hand to favor the development of more gaudy coloration in males where this is needed for bluffing, and on the other hand, to more powerful jaws and muscles where these are of value in fighting. Further aids to sex recognition such as the hunched posture of *S. undulatus* would be conserved by natural selection since it has obvious utility. By way of comparison, it may be noted that in snakes, in which odor of the cloacal glands serves as the basis of sex recognition, and in frogs, in which body size, voice and movement function in sex discrimination, a sexual dimorphism of color is of rare occurrence.

The copulation postures of lizards apparently have some systematic value; at least those of the iguanids studied approach that of the skink, while those of the teiids are alike and readily distinguished from those of the lizards of other families, including Lacertidae. The male of *E. fasciatus* bites one side of the neck region of a female and holding his body on the opposite side of hers, throws his tail under hers until their cloacas are brought close together. His limbs are used to hold the female down while maintaining his position. In *Anolis* and *Leiocephalus*, the original grip is the same, except that it is usually more dorsal. Further, this neck hold may be released after one hemipenis has been inserted into the female cloaca. In *Sceloporus* it is also the same, but the struggling female may turn on her back if the grip on the neck is not in the right position. However, copulation never proceeds when the ventral surfaces of the sexes are opposed. In *Leiocephalus*, after the female has been seized, the male attempts to stimulate her to mate by rubbing one thigh back and forth along her back in the pelvic region. This was noted in four of thirteen recorded courtships and probably occurred in others. In *A. chrysolaema*, the male follows the female about the cage, usually walking with her body between his legs. The male endeavors to press his snout against the nape of the female's neck. In only four of forty-eight courtships did the male actually bite the neck of the female. At frequent intervals one of the thighs is rubbed along the axis of the female's body in the pelvic region. The femoral organs which protrude as combs, serve as scratching organs, and tend to quiet the female or to stimulate her to mate. These thigh movements were noted in forty of the forty-eight recorded courtships and probably occurred in all. After a minute or more of this activity, the male suddenly turns and bites the inguinal region of the female opposite to the side on which his body happens to be. At the same moment he throws his tail under hers and arches his body in a semicircle over her body while he inserts the hemipenis of the side adjacent to her body. In *Lacerta* the male has been reported to bite the flank of the female, but it is done on the side of approach, and this movement is not preceded by either the neck poking or the thigh rubbing. In *Cnemidophorus sexlineatus* the copulation posture was observed by us to be the same as in *Ameiva*.

The function of the femoral organs in *Ameiva* is to stimulate and not merely to hold the female as previous observers have assumed. However, other lizards devoid of these organs may practice similar rubbing movements of their thighs (*Leiocephalus*), and lizards having poorly developed organs may not use them for this purpose (*Sceloporus*). In the latter genus, the habit may have been given up, since *Sceloporus* represents an advanced type.

Other specific differences in the mating of lizards have a more obscure functional significance. For example, both sexes of *Ameiva* and *Cnemidophorus* remain quiet

after the hemipenis is inserted, while in *Sceloporus* the bodies of both sexes often quiver violently. In *Anolis* the copulation lasts longer than in the other iguanids and infrequent forward movements of the pelvic region may occur in the male. Similar movements were recorded once in *Leiocephalus*. In *Eumeces*, these movements are rhythmic and proceed from the tail base forward a short distance. Apparently in some species muscular movements in the cloacal region aid in the process of shedding the sperm while in other species these movements, if present, are not visible externally. There are also specific differences in the length of copulation, the degree to which the hemipenes are exposed, the reaction of the sexes after copulation and in various other features to be considered in the full report.—G. K. NOBLE and H. K. TEALE, *American Museum of Natural History, New York.*

SOME STAGES IN THE ADAPTIVE RADIATION OF THE TELEOSTOME SKULL.—A study of about 150 teleost and ganoid skulls of many orders and families had been made and the sutural limits of the individual elements determined so far as possible. Drawings had been made under the author's direction by Mrs. Louise Nash. The nomenclature of the skull elements adapted was conservative in intention, changing widely accepted names only in one or two cases where they had definitely shown to convey entirely misleading homologies with the elements of the skulls of the oldest tetrapods. In a comparison of the skull pattern of one of the oldest fossil ganoids with that of an anaspid ostracoderm of Silurian age, as figured by Kiaer, it was shown that there are profound differences between the two: e.g., in the agnathous ostracoderm the mouth is very large and the minute circular gill openings are widely removed from it; in the ganoid the oromandibular arches are only a little larger than the large gill arches and are in series with them; also the orobranchial series are all folded obliquely backward, the first overlapping the second, the second overlapping the third and so on in such a way that the water passing in at the mouth flowed obliquely backward and outward through the gill slits. The hypothesis was put forward that this V-shaped arrangement had been initiated in an early gnathostome stage in which the throat was flat and the head rounded above, in connection with partly bottom living habits; selection for active free swimming and predatory habits might then have brought about the elongation of the median parts of the lower jaw and the backward elongation of the head and body, with a consequent increase in the obliquity of the Vs.

The macropetalichthyids and arthrodires, although in themselves specialized side branches, seem to have sprung from the border zone between the Agnatha and the early gnathostomes, and were more or less intermediate between the primitive bottom-living fishes and the free swimming predaceous types.

The main stages in the subsequent evolution of the fish skull were then traced with special reference to the adaptive radiation of the jaws.

Postscript: Origin of the V-shaped Arrangement of the Orobranchial Apparatus of Fishes

In the cephalaspid ostracoderms as described by Stensiö (1927) the first six gills of the ten gill sacks extend directly laterad, having small round external openings, as in the lampreys. In the latter the branchial basket is a delicate, stiffening skeleton of cartilage, without joints. In the primitive shark (e.g. *Chlamydoselachus* as described by Allis, 1923) the jaws and gill slits are directed obliquely backward, the stout branchial skeleton is elaborately segmented and jointed; the jaws and branchial arches are surrounded externally by band-like constrictor muscles (Cs 1, 2, 3, etc.).

According to the hypothesis here put forward the primitive chordates were comparatively sluggish, bottom-living forms, feeding on small organisms. Progressive selection for free-swimming, predaceous habits led to the enlargement of the oromandibular and branchial arches and of their surrounding constrictor muscles. The rhythmic contraction of these muscle bands would tend to bend and fold the enlarging orobranchial arches and to break them up into joints. Further enlargement beneath the shell of constrictor muscles, together with the advantages of a narrower head in rapid swimming, would lead directly to the obliquity of the jaws and arches as seen from below and to their flexures in the lateral view.—WILLIAM K. GREGORY, *American Museum of Natural History, New York.*

EDITORIAL NOTES AND NEWS

The New York Meeting

THE thirteenth stated meeting of the American Society of Ichthyologists and Herpetologists was held on May 20 and 21, 1930, in the American Museum of Natural History, New York City. Special features of this meeting were: the splendid entertainment by the New York Zoological Society at the evening smoker in the New York Aquarium; the luncheons provided by the American Museum; the annual dinner; and three fine sets of motion pictures—Gilbert C. Klingel's "Rhinoceros Iguana Studies," Grace Olive Wiley's "Reptile Studies" and a special selection of Raymond L. Ditmar's recent motion pictures of reptiles. The rhinoceros iguana pictures were accompanied by a running account of these peculiar lizards, and of the expedition undertaken to secure the films. Miss Wiley's pictures and talk showed how well she succeeded in taming poisonous and supposedly vicious reptiles so that even small children play with them. The close-up of a rattlesnake shedding was a particularly fine piece of natural history photography. Raymond L. Ditmars preceeded his fine pictures with a very interesting address, in which he presented data on the longevity and care of reptiles in captivity. He also exhibited rare snakes and a series of king snakes showing geographical variation, and announced the preparation of a popular handbook on the poisonous reptiles of the New World. His pictures showed poisonous and non-poisonous snakes; the extraction of venom, etc.

R. H. Hutchison and R. E. Stadelman of the Antivenin Institute of America kindly provided an interesting and graphic account of the incidence of snakebite poisoning in the United States, and of the work of the Antivenin Institute. The presentation was concluded by a demonstration of live specimens of poisonous snakes.

Another feature of the meeting was the splendid series of Exhibits which had been arranged for by the Local Committee. The exhibits were headed by a showing of fine exotic aquarium fishes by the New York Aquarium Society. The titles of the exhibits follow:

1. **Exhibit of Exotic Fishes by the New York Aquarium Society.**
2. **Exhibit of Rare Amphibia.** M. K. Brady, The American Museum of Natural History.
3. **New Deep Sea Fishes, collected in 1928-1929.** N. A. Borodin, Museum of Comparative Zoology.
4. **Head of an Adult Chlamydoselachus.** E. W. Gudger, The American Museum of Natural History.
5. **Two Uterine Embryos of Chlamydoselachus.** E. W. Gudger, The American Museum of Natural History.
6. **Drawings by Bashford Dean showing the Development of Fishes.** E. W. Gudger, The American Museum of Natural History.
7. **The Effect of Marine Life on the Kidney of Fishes.** Homer W. Smith, New York University and Bellevue Hospital Medical College and E. K. Marshall, Johns Hopkins University.
8. **The Induction of Sexual Maturity in Lizards by Pituitary Transplants.** G. K. Noble and H. K. Teale, The American Museum of Natural History.
9. **The Induction of Egg Laying in Salamanders by Pituitary Transplants.** G. K. Noble and L. B. Richards, The American Museum of Natural History.
10. **Metamorphic Changes Produced in Siren and Cryptobranchus by Thyroid Treatment.** G. K. Noble and L. B. Richards, The American Museum of Natural History.
11. **The Hatching Mechanism in Ambystoma.** G. K. Noble and M. K. Brady, The American Museum of Natural History.
12. **Relationships and Variation in Chinese Loaches.** J. T. Nichols, The American Museum of Natural History.
13. **Adaptations in Chinese Frogs.** C. H. Pope, The American Museum of Natural History.
14. **Mounting by Paraffin and Wax Infiltration in the Field.** W. G. Hassler, The American Museum of Natural History.
15. **Incubation Period of Hemidactylus brooki Gray and Sphaerodactylus difficilis Barbour.** H. K. Teale, The American Museum of Natural History—See abstract in this number of COPEIA.
16. **The Eggs and Larvae of Cryptobranchus.** B. G. Smith, New York University and Bellevue Hospital Medical School.
17. **The Eggs of Pseudobranchus.** G. K. Noble, The American Museum of Natural History. See abstract in this number of COPEIA.
18. **Further Studies on the Effect of Light on the Eyes and Pigmentation of the Cave Salamander, Typhlotriton.** G. K. Noble and S. H. Pope, The American Museum of Natural History.

A general discussion of the West Indian Problem was lead by Emmet R. Dunn, Haverford College, with a paper on "Central American relationships of the Greater

Antillean fauna," in which the comparisons of the island faunas were made on the basis of the respective numbers of independent migrations indicated.

A Symposium was held on the flight of fishes. Carl L. Hubbs, University of Michigan, discussed "Field observations on the flight of fishes treated in especial reference to the evolution of flight." C. M. Breder, Jr., New York Aquarium, followed with a contribution "On the structural specialization of flying fishes," considered from the aerodynamic viewpoint; the paper to be published in the next number of COPEIA. J. T. Nichols, American Museum, concluded the stated program with general remarks on fish flight. A general discussion followed.

In addition to these general features, twenty papers were read and discussed:

1. **The segmentation of the egg in the myxinoid, Bdellostoma stouti.** B. G. Smith, New York University and Bellevue Hospital Medical College.—An account of the unfinished work of the late Bashford Dean, now being completed by Dr. Smith. Illustrated by Dean's drawings and by sketches. To be published in the "Dean Memorial Volume."
2. **Ichthyological notes and comments.** William C. Kendall, United States Bureau of Fisheries.—Remarks on current trends in ichthyology, with especial reference to the Salmonidae, and to the recently published manual and check-list of American fishes. Paper read by J. T. Nichols, owing to illness of Dr. Kendall.
3. **Further results in hybridizing sunfish genera.** Carl L. Hubbs and Laura C. Hubbs, University of Michigan.—To be published in the next number of COPEIA, and in part in the Papers of the Michigan Academy of Science, Arts and Letters.
4. **Remarks on certain neotropical life histories.** M. Graham Netting, Carnegie Museum.—Based on observations on the amphibians of Trinidad.
5. **A new reconstruction of Dinichthys.** Anatol Heintz, Palaeontological Museum of Oslo.—Dr. W. K. Gregory welcomed Dr. Heintz to the Society, and commented on his recent work at the American Museum. The paper was read by Miss La Motte.
6. **Notes on the distribution and life history of the Pacific fresh water turtle.** Tracy I. Storer, University of California. Extended discussion.
7. **Present status of the axolotl problem.** E. R. Dunn, Haverford College. Considered in special reference to the number of species confused under the name "Axolotl."
8. **The habitat of Stereochilus.** M. K. Brady, American Museum.—This rare salamander held to be characteristic of the pine barrens, as a result of extensive collecting in North Carolina and Virginia.
9. **Some notes on the Atlantic deep sea fishes.** N. A. Borodin, Museum of Comparative Zoology.—A general account of two collections of deep-sea fishes, made by C. Iselin and associates on oceanographic cruises in 1928, from New York to the Azores, and in 1929, from Woods Hole to Bermuda; the rare and new species listed; the difference in the species obtained on the two trips outlined; the conclusion drawn "that different species of deep-sea fishes are not cosmopolitan, as they were sometimes supposed to be, but their fauna presents, on the contrary, a striking difference even in two regions of the same ocean, situated comparatively near to each other, but having different hydrobiological conditions." Illustrated by specimens of rare and bizarre forms. Preliminary papers have appeared in Proc. N. E. Zool. Club (10, 1929: 109-111, and 11, 1930: 87-92); full paper to appear in Bull. Mus. Comp. Zool.
10. **Some commercial aspects of herpetology.** Lenore Andrews, New York.—An account of the established industry in snake skins in India, with reference to its economic significance; proposals for greatly expanding and systematizing this industry by scientific development of snake cultivation.
11. **Some stages in the adaptive radiation of the teleostome skull.** W. K. Gregory, American Museum.—Abstract published in this number of COPEIA.
12. **The natural history of Japanese frilled sharks, Chlamydoseiachus anguineus.** E. W. Gudger, American Museum.—Another account of work done by the late Bashford Dean. Illustrated by Dean's drawings. To be published in the "Dean Memorial Volume."
13. **Field observations on Cuban reptiles and amphibians.** J. A. Weber, Leonia, New Jersey.—This paper and the next illustrated by live specimens obtained on the expeditions.
14. **Field experiences with some Cuban reptiles and amphibians.** Arthur Greenhall, New York.
15. **The relation of some Chinese frogs to their environment.** C. H. Pope, American Museum.—An analysis of the adaptation of certain Chinese frogs, to torrential currents. Illustrated by lantern.
16. **Observations on the life history of Aristelliger lar.** W. G. Hassler, American Museum.—Read by title, because of illness of Mr. Hassler.
17. **Remarks on the Cyprinid genus Oreoleuciscus.** J. T. Nichols, American Museum.—In part published in COPEIA, 1930 (1): 16.
18. **A recently described gymnotid genus from Mt. Duida.** Miss Francisca La Motte, American Museum.—Further notes on the interesting new genus recently described in the "American Museum Novitates"; its relation to the peculiar fauna of the Mt. Duida region discussed.
19. **The courtship of the plethodontid salamanders.** G. K. Noble and M. K. Brady, American Museum.—Abstract published in this number of COPEIA.
20. **The courtship of some iguanid and teiid lizards.** G. K. Noble and H. K. Teale, American Museum.—Abstract published in this number of COPEIA.

The officers elected for the year 1930-31 are: Honorary President, John Treadwell Nichols, American Museum; President, Emmet R. Dunn, Haverford College, Haverford, Pennsylvania; Vice Presidents, William Converse Kendall, U. S. Bureau of Fisheries, Freeport, Maine; Karl P. Schmidt, Field Museum, Chicago, Illinois; M. Graham Netting, Carnegie Museum, Pittsburgh, Pennsylvania; Treasurer, T. L. Hankinson, State Normal College, Ypsilanti, Michigan; Secretary and Ichthyological Editor, Carl L. Hubbs, Museum of Zoology, University of Michigan, Ann Arbor,

Michigan; Herpetological Editor, Mrs. Helen T. Gaige, Museum of Zoology, University of Michigan, Ann Arbor, Michigan; Corresponding Secretary, John R. Greeley, Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

It was voted that the Secretary should send a letter to members of the House Appropriations Committee commending them on furnishing means for the Reptile House now under construction in the National Zoological Park. It was decided to hold the next annual meeting at Philadelphia in conjunction with the meeting of the Mammalogists, and was provisionally decided to hold the 1932 meeting in Washington. A Standing Advisory Committee on Aquarium and Terrarium Culture, as recommended by the Secretary, was appointed, with the following members: William M. Mann; C. M. Breder, Jr.; George S. Myers; Myron Gordon. A Committee on the Constitution was also named: W. K. Gregory and G. K. Noble.

The Secretary reported that the Society is continuing a healthy growth, although it is much smaller than the general interest in ichthyology and herpetology makes necessary. The Society ought to double in combined membership and subscription in the next few years. The increase in foreign subscriptions and memberships is especially desirable, in that it enlarges and broadens the Society, extends its interest and prestige, and makes the journal more available and useful throughout the world. It is a source of extreme regret that so few libraries take COPEIA. This is a limitation of course to the income of the Society, but of more importance, it is a limitation on the usefulness of the journal, now and in the future, in this country and more especially in other lands. Now COPEIA is available in only nineteen countries. For the sake of both the Society and journal, a drive to increase the library subscriptions to COPEIA is called for. The cooperation of all members is requested, especially in inducing the local institutions to subscribe.

Meeting of the Western Division

IN conjunction with the meeting of the American Association for the Advancement of Science held at the University of Oregon, at Eugene, the Western Section of the American Society of Ichthyologists and Herpetologists met on June 19. A program of eight papers was presented.

1. **The reaction of the halibut to the strain of overfishing.** W. F. Thompson, International Fisheries Commission.
2. **Mechanics of respiration in turtles (Chrysemys elegans and C. bellii) with notes on behavior under low oxygen tension.** Ralph Shaw and F. M. Baldwin, University of Southern California.
3. **Notes on the habits of a rare East Indian eel.** Albert W. Herre, Stanford University.
4. **A study of certain measurable characters for comparisons of salmonoid fishes in Western Washington.** Loyd Royal, University of Washington.
5. **Notes on the life history of Cymatogaster aggregatus as revealed by scale study.** Arnie Suomela, University of Washington. By title only.
6. **The fisheries of the East Indies.** Albert W. Herre, Stanford University.
7. **A statistical study of the growth of the lamprey, Lampetra planeri, from Western Washington.** Leonard P. Schultz, University of Washington. To be published in Occasional Papers of the Museum of Zoology, University of Michigan.
8. **Distribution of the true fresh-water fishes of the Western United States.** John Otterbein Snyder, Stanford University.

Exhibits were held of the tadpoles of the American discoglossid toad, *Ascaphus truei*, of *Ambystoma paroticum* of two forms, with larvae, and of *A. decorticatum* and *A. macrodactylum*, all by James R. Slater, and the extremely rare and peculiar fish *Empetrichthys merriami*, from desert springs in the Death Valley region, by Mr. Myers.

The officers of the Section elected are: President, Will F. Thompson; Vice President, Philip Pope; Secretary-Treasurer, George S. Myers.

The next meeting of the Section will be held in Pasadena, California, next June.

Back Numbers of Copeia

ATTENTION needs be called to the fact that the supply of some back numbers of COPEIA is exhausted, and that the stock of other numbers is very low. It was agreed that the price for such numbers be raised. Any members having duplicate copies of back numbers which they do not need, would confer a great favor on the Society by sending these to the Editor. It is especially desired that some copies be obtained of the numbers now exhausted, namely, 128, 129, 130, 131, 134, 136, 137, 138 and the indices for 1913-1914, 1913-1915, 1918, 1919, 1920, 1921, 1922, 1923 and 1924.

Fishery Institutions in America

FOLLOWING the death of Dean Cobb (see obituary note in this number of COPEIA), the fisheries organization at the University of Washington, at Seattle, has been reorganized. The College of Fisheries, the only one in America, is changed to a Department of Fisheries in the Science College. Will F. Thompson has been appointed Research Professor of Fisheries, and Instructor Leonard P. Schultz has been retained to continue the instruction in ichthyology. It is expected that the staff will be increased. The stress in the fisheries work will be transferred from the technological and fish cultural aspects to fishery biology. The Puget Sound Biological Laboratory becomes the University of Washington Oceanographic Laboratory, which will no doubt be related to the fisheries investigations. The continued association with the International Halibut Commission, under the direction of Dr. Will F. Thompson, and the centering of Bureau of Fisheries work in its new laboratory under construction at Seattle, will make of the University of Washington a great center for marine fisheries research.

The Institute for Fisheries Research of the University of Michigan was established February, 1930, to conduct the fishery investigations of Michigan waters. The field is largely though not wholly limited to the inland waters of the state and to sport fishery problems, because the Great Lakes Laboratory of the United States Bureau of Fisheries is undertaking investigations of the commercial fisheries of the Great Lakes. These two investigating units have their headquarters in the Division of Fishes of the Museum of Zoology of the University of Michigan. Graduate students, assistants, and fellows in these ichthyological units enroll for advanced degrees in the Department of Zoology of the University, in which a Division of Ichthyology and Fisheries Research has been designated. The Institute for Fisheries Research deals primarily with definite problems of practical application, for it is subsidized by the State Department of Conservation. Among the problems now being studied are a general lake and stream survey of the state, leading to fish management recommendations; analysis of the creel census statistics of inland waters; diagnosis and suggested treatment of diseased fish, especially in hatcheries; the migratory habits of trout, determined by tagging experiments; the food and competitive interrelations of trout and other fishes; the cause of dwarfing of perch and other species; the development of the fish supply by modifying conditions in nature (snagging trout streams; providing spawning beds in lakes, etc.). The staff of the Institute (for the latter part of 1930) is: Director, Carl L. Hubbs; Fish Pathologist, Wendell H. Krull; Assistant to Director, John R. Greeley; Assistants, Gerald McCrimmon and Samuel N. Jones; Secretary, Orel Shoebridge; Fellows, J. Clark Salyer, Clarence Tarzwell, R. W. Eschmeyer, and Laurence M. Ashley.

Expedition News

WE learn from the Director's report of the Field Museum that Karl P. Schmidt and Albert W. C. Herre made valuable collections of reptiles and fishes on the Crane Pacific Expedition; a new freshwater fish fauna is reported as discovered in the Sepik River, New Guinea. The recent announcement of the resumption of the Asiatic explorations of the American Museum is received with interest by all zoologists. Carl L. Hubbs returned last fall from Java and Japan with a very large collection, especially rich in material from the Sea of Japan. E. R. Dunn is continuing his studies on the life history of amphibians on Barro Colorado Island this summer. He recently studied the axolotl problem, both in Europe and Mexico. A University of Michigan expedition to northeastern Mexico has just returned with a rich collection of fishes and some reptiles and amphibians. Expeditions for collecting cold blooded vertebrates for the same university are in the field in various parts of eastern and central United States. William Beebe is continuing his intensive ichthyological collecting in Bermuda. George S. Myers and Joseph Wales report a successful trip to the Death Valley region, for collecting the fishes of the desert springs.

Correction

"A NOTE on *Anniella nigra* Fischer," published in COPEIA, No. 173, pp. 95-96, was inadvertently accredited to M. E. Musgrave. The author is Edna M. Fisher, Museum of Vertebrate Zoology, University of California.